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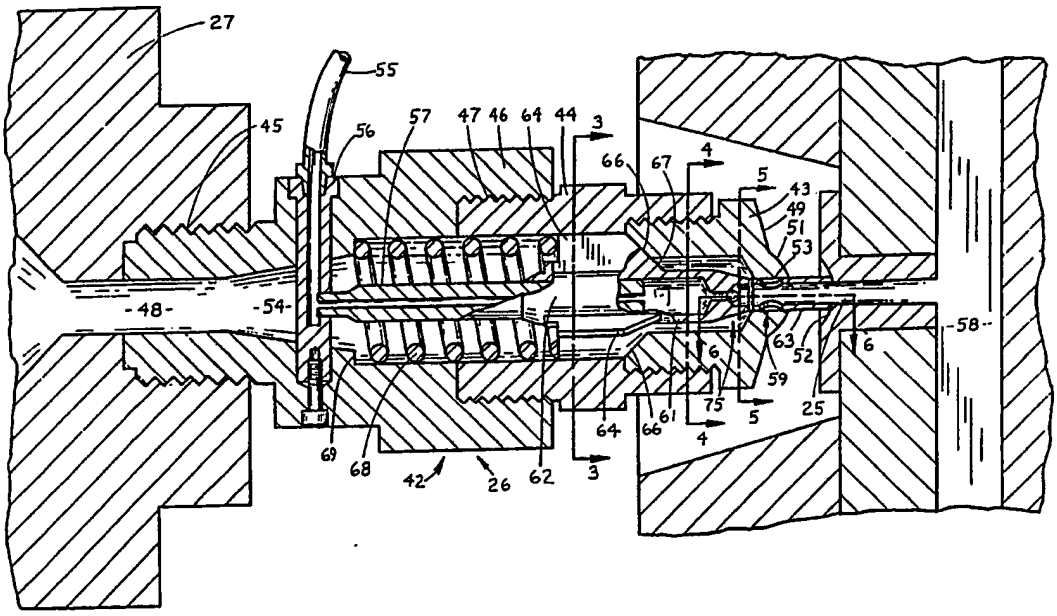

(57) Abstract

The nozzle unit (26) for an injection molding machine has an air supply tube (55-57) and a plastic material supply chamber (54) and a valve means (59) for selectively controlling the injection of air and/or plastic, separately or intermixed, into a mold cavity (58). The air may also be introduced into the mold cavity prior to or after the injection of the plastic material, and the volume of plastic material can be varied for successive injections to provide for molded articles of varying size and design charac teristics.

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METHOD AND INJECTION NOZZLE UNIT FOR MOLDING A PLASTIC ARTICLE

This invention relates to an injection nozzle unit and method for molding plastic articles having predetermined density and surface characteristics.

Injection nozzles for injecting a plastic material into a mold cavity separately or concurrently with a blowing agent or mixed with air or gas are well known. To obtain these various type molded articles generally requires different type injection nozzle units. However, even with different nozzle units utilized for specific purposes, difficulties are encountered in efficiently and economically producing quality molded plastic articles due to nozzle clogging, especially in the molding of fiberglass articles, or to residual material remaining in the nozzle unit following an injection operation so as to impair the quality of a next mold injection. Additionally, in some instances, a too rapid flow of the injection material into the mold cavity results in surface irregularities or in the incomplete forming of mold details in the finished molded article.

This invention provides a nozzle unit adapted to handle different plastic compositions efficiently and economically to produce quality molded articles. The injection material can be injected alone or intermixed with a suitable gas or air which will hereinafter collectively be referred to as "a gas". The plastic material can be injected alone into the mold cavity and the gas can be injected into the mold cavity prior to or following a plastic injection. The plastic, therefore,

can be injected into a gas pressurized mold cavity or following a plastic injection operation gas can be used to clear the nozzle unit of residual plastic concurrently with assuring a complete filling of the mold cavity with plastic. As a result of this controlled injection of a gas and/or plastic material, quality molded articles are efficiently and economically produced.

Fig. 1 is a rear perspective view of an injection molding machine embodying the nozzle unit of this invention;

Fig. 2 is an enlarged longitudinal sectional view of the nozzle unit shown generally in Fig. 1;

Figs. 3, 4, 5 and 6 are sectional detail views taken along the lines 3-3, 4-4, 5-5 and 6-6, respectively, in Fig. 2;

Fig. 7 is a sectional detail view showing the coacting relation of the nozzle unit with the inlet of a mold cavity for injection into the mold cavity of a gas only;

Fig. 8 is a sectional detail view illustrated similarly to Fig. 7 showing parts in changed positions;

Fig. 9 shows the nozzle unit in position for the injection of a fiberglass and plastic composition material into a mold cavity;

Fig. 10 is illustrated similar to Fig. 9 and shows the nozzle unit in position for cutting off the injection of the composite fiberglass and plastic material into the mold cavity;

Fig. 11 is illustrated similar to Fig. 10 and shows the nozzle unit out of operative association with the mold cavity inlet and the resultant cylindrical residual core on the molded article;

Fig. 12 illustrates the relative arrangement of the nozzle unit parts for concurrently injecting a composite plastic material of incompatible plastics mixed with a gas for injection into a mold cavity to produce a

molded container having a gas permeable wall structure;

Fig. 13 illustrates the completion of a plastic injection operation wherein the mold cavity has an unfilled void and residual plastic remains in the nozzle unit;

Fig. 14 illustrates the residual plastic shown in Fig. 13 being injected into the mold cavity by a pressurized gas to fill the cavity void concurrently with clearing the nozzle unit of the residual plastic;

Fig. 15 illustrates the injection of a plastic material into a mold cavity against atmospheric pressure;

Fig. 16 illustrates the tendency of the leading edge or surface of plastic being injected against an atmospheric pressure to shatter or disrupt during the filling of the mold cavity;

Fig. 17 illustrates the injection of a plastic material into a prior gas pressurized mold cavity and the resultant smooth flow of the material into all portions of the cavities sidewall by a controlled rate of release of the pressurized gas to retain the leading surface of the injected plastic material against disruption; and

Fig. 18 is a diagrammatic illustration of a computer programmed control circuit for operating the nozzle unit in accordance with specified injection requirements.

With reference to the drawings, there is shown in Fig. 1 a molding machine 20 with an elongated main frame 21 having a mold unit 22 positioned adjacent one end 23 to be hereinafter referred to as the forward end of the main frame 21. The mold 24 has a cavity inlet 25 arranged for operative association with the nozzle unit 26 of this invention.

The nozzle unit 26, shown generally in Fig. 1, is mounted at the forward end of an injection barrel 27 for a screw 29 driven by a motor 31 supported on a mounting member 37 on a carriage 33. The injection barrel

projects forwardly from a cross head 32, supported on the carriage 33. The cross head additionally supports a pair of cylinder assemblies 34 arranged to opposite sides of the barrel 27 with their associated piston rods 36 carried in the mounting member 37 for the motor 31. The cylinders 34 operate to move the barrel 27 relative to the injection screw 29 during an injection operation, with the material to be injected being admitted to the barrel 27 from a hopper 28. The nozzle unit 26 is movable into and out of operative association with the mold cavity inlet 25 on a reciprocal movement of the carriage 33 relative to the machine frame 21. This reciprocal movement is responsive to the operation of a double acting cylinder 38 pivotally interconnected between the carriage 33 and the frame 21 and the operation of which is controlled by a linear transducer 39 mounted on the frame 21 for coacting engagement with a limit member 41 on the carriage 33.

The injection nozzle unit 26 of this invention (Fig. 2) includes a housing unit 42 comprised of three sections, namely, a forward section 43, a central section 44, and a rear section 46 which are threadably interconnected as indicated at 47, with the rear section 46 in threadable connections at 45 with the forward end of the injection barrel 27. The housing unit 42 is of a generally cyclindrical tubular shape having a material inlet 48 in the rear housing section 46 open to the forward end of the injection barrel 27. The forward housing section 43 has a front wall 49 formed with a central projected dome 51 for coacting engagement with the concave depression 52 at the outer end of the mold cavity inlet 25. The front wall 49, which constitutes the front wall of the housing unit 42, has a bore 53 of a reduced section relative to the housing axial bore 54 for a purpose to appear later. In this respect, it is to be noted that the bore 54 is of varying diameters as it extends through the connected housing sections 43, 44 and 46.

A supply tube 55 for supplying a gas to the mold cavity includes a lateral section 56 positioned transversely of the rear housing section 46 to which is secured a longitudinal section 57 extended axially of and within the housing bore 54 for the termination adjacent the rear end of the housing front section 43.

The admission of plastic material from the housing bore 54 into the mold cavity 58 is under the control of a valve means indicated generally at 59 (Figs. 2 and 6) and including a tubular generally cylindrical shaped valve member 61 and the reduced bore section 53 in the housing front wall 49. The valve member 61 has a main body section 62 slidably mounted on the gas supply tube section 57 and a front end portion 63 of a reduced diameter. An axial bore in the valve member 61 has bore sections of varying diameters over the length thereof. The rear end portion of the body section 62 has a series of three radially extended vanes 64 (Figs. 2 and 3), the extremities of which are in guidable engagement with the inner peripheral surface of the bore 54 in housing section 44 to guide reciprocal movement of the valve member axially of the housing unit 42.

The junction of the housing sections 43 and 44 is defined by a shoulder 66 (Fig. 2) for abutting engagement with the forward ends 67 of the vanes 64 to limit forward movement of the valve member 61 relative to the housing unit 42. A compression spring 68 is mounted about the longitudinal section 57 of the gas supply tube and arranged in compression between the vanes 64 and a shoulder 69 located forwardly of the gas supply tube lateral section 56 and formed in the housing bore 54 within the rear housing section 46. The spring 68 functions to continuously urge the valve member 61 into engagement with the shoulder 66.

As shown in Figs. 2 and 7, when the valve member 61 engages the shoulder 66 the front end section 63 thereof is moved forwardly of the front end 70 of the

supply tube section 57. A check valve unit 75 is carried in the valve member 61 forwardly of the supply tube section 57 and rearwardly of the reduced end section 63 of the valve member 61 which section 63 is guidably supported for reciprocal axial movement within the bore 53 to function as a slide valve within an annular bearing formed by the inner peripheral surface of bore 53. The check valve 75 (Figs. 5 and 6) operates in response to pressure differences at the opposite ends thereof to control the supply of gas from the tube 55 and through the slide valve 63 into the inlet 25 of the mold cavity 58.

The slide valve section 63 of the valve member 61 (Figs. 6 and 7) is formed with radially extended passage ways 71 that are positioned within the bore 53 when the valve member 61 is in abutting engagement with the shoulder 66 on the housing unit 42. In this position, the valve member 61 cuts off the travel of plastic material into the mold cavity 58 from the housing bore 54. With the valve member section 63 positioned in registration with the cavity inlet 25 the check valve 75 is movable to an open position to provide for the admission of gas from the supply tube 55 into the mold cavity 58.

To inject a plastic material into the mold cavity 58, the nozzle unit 26 is movable forwardly as a unit relative to the valve member 61 from its position shown in Fig. 7 to the position thereof shown in Fig. 8. By virtue of the valve member section 63 being engaged at the mold cavity inlet 25 this forward movement results in a compression of the spring 68 and movement of the housing 42 in a direction forwardly of the valve member 61 to the position shown in Fig. 8 wherein the dome 51 on the front wall 49 of the housing is received in a nested relation within the depression 52 at the mold cavity inlet 25 and the passages 71 are moved inwardly of the housing 42 and out of the bore 53. Plastic material

within the bore 54 of the housing 42 is thus permitted to flow through the passages 71 and the slide valve section 63 into the mold cavity 58.

On a withdrawal or rearward movement of the housing 42 out of engagement with the mold inlet 25 and retraction of the passages 71 within the bore 53, the flow of plastic through the passages is positively cut off by coacting action of the shoulder 72 at the inner end of the bore 53 with the rear or trailing edges 73 of the passages 71 (Fig. 8). This cutting action takes place in response to the yieldable pressure applied by the spring 68 urging the valve member 61 into engagement with the housing 42 at the shoulder 66. During the injection of plastic material, and as illustrated in Fig. 8, the check valve 75 is moved to a gas closing position therefor by the pressure applied thereon by the injected plastic material.

As thus far described, it is seen that when the slide control 63 of the member 61 is in the plastic closed position therefor, shown in Figs. 6 and 7, gas alone may be injected into the mold cavity 58 from the supply tube 55. During this gas injection the check valve 75 is moved to its open position by the pressure applied thereon by the gas from the supply tube 55. With the slide control valve 63 in the plastic open position therefor, shown in Fig. 8, and the gas supply to the tube 55 shut off, the check valve 75 is moved to its gas closed position by the pressure applied thereon by the injected plastic so that plastic alone is admitted to the mold cavity 58. However, in this plastic open position of the slide control valve 63 gas may be injected into the mold cavity concurrently with the plastic material by applying a gas pressure on the check valve 75 greater than the counter pressure applied thereon by the plastic material.

In the operation of the nozzle unit 26 of this

invention, it is contemplated that each injection operation be controlled by a programmed computer so that (1) gas may be injected into the mold cavity either before or after the injection therein of a plastic material, (2) the shot volume of the injection operation may be varied and (3) gas and plastic can be injected together into the mold cavity. There is illustrated in Fig. 18 a computer programmed control system having a source 74 of a gas or air supplied under pressure by a pump 76 through a line 77 provided with a computer actuated solenoid valve 82 which regulates the gas flow to a pressure transducer 78 that admits the gas to the supply tube 55. A pressure release line 79 carries a computer activated solenoid valve 81 which operates reversely relative to the solenoid valve 82 in the line 77; namely, when the valve 82 is in open position, the valve 81 is in the closed position therefor and in turn, valve 82 is in the closed position when valve 81 is in an open position. This concurrent actuation of the valves 82 and 81 takes place in response to the computerized program.

The movement of the slide valve portion 63 of the valve member 61 into and out of engagement with the mold inlet 25 takes place in response to the operation of the cylinder 38 which is actuated by the linear transducer 39 having connection with the computerized control system. The signal from the linear transducer 39, through the computerized system, actuates solenoid valves 83 and 84 which control the supply of oil from a reservoir 85 to the double acting cylinder 38. The reciprocal movement of the injection housing 27 and injection nozzle unit 26, as a unit with respect to the injection screw 29, is responsive, as previously described, to the operation of double acting cylinders 34 for movement in one direction by a computer actuated solenoid valve 86 and movement in an opposite direction by the pressure of the plastic material collected or accumulated on the

front side or end of the injection screw 29.

In this respect, it is to be noted that the injection barrel or housing 27 is heated to a predetermined temperature, depending upon the characteristics of the plastic material being injected, by suitable heating elements mounted thereon and indicated at 88 (Fig. 1). The computer system (not shown) for controlling the operation of the control circuits shown in Fig. 18 provides for the injection operation of the nozzle unit 26 in a predetermined manner dependent upon the composition of the injection material and the design characteristics or specification of the article to be molded.

In Figs. 9, 10 and 11 there is illustrated the operation of the nozzle unit 26 for the injection into a mold cavity 92 of a fiberglass-plastic material. Generally, in the injection of material mixture of this type there remains at the termination of injection a ragged or shredded end of the mixture within the injection nozzle and a corresponding ragged or shredded end of the material at or within the inlet 91 to the mold cavity 92. In other words, on termination of the injection operation the mixture is pulled apart at the injection nozzle rather than being efficiently cut off. In Fig. 9 the plastic fiberglass material 89 is being injected from the housing bore 54 and through the passage ways 71 into the mold inlet 91. On movement of the housing 42 relative to the valve member 61, to their positions shown in Fig. 10, the material 89 is sheared or cut off on entry of the passage ways 71 within the bore or annular seat 53 by the coaction of the shoulder 72 at the inner end of the bore 53 with the rear sides or edges 73 of the passage ways 71. Thus, as shown in Fig. 11, a clean cut edge 95 of the material remains within the nozzle 26 with a corresponding clean cut edge 93 at the trailing edge of the residual material 94 remaining within the mold inlet 91 and removable from the mold cavity with the

completed article. It is seen, therefore, on the next successive injection of material, the injection takes place freely without obstruction from any residual portions of material within the nozzle or at the mold cavity inlet.

In Fig. 12, there is illustrated the operation of the injection nozzle 26 for the molding of a container article requiring porous sidewalls such as a flower pot indicated for the mold cavity 58a. In this example, the material to be injected is comprised of a couple of incompatible plastic material materials such as a polyethylene and styrene materials which are mixed in the proportions by weight of 60 percent of a polyethylene to 40 percent of a styrene or 40 percent of a styrene to 60 percent of a polyethylene. Incompatible nylon and rubber materials may also be used in the same reversed proportions by weight.

On being heated, the separation of the contiguous incompatible materials is retained in the melted mixture. Simultaneously, with the injection of the incompatible plastics mixture, gas is supplied from the gas supply tube 55 into the mixture at a pressure slightly greater than the pressure of the injected material so as to be intermixed with such material on entry into the mold cavity 58a. This mixing of air or gas with the incompatible plastic mixture results in the formation of air voids 96, shown enlarged in Fig. 12, that are interspersed between contiguous portions of the incompatible plastics of a size to form a gas pervious sidewall in the molded container.

Figs. 13 and 14 illustrate the operation of the injection nozzle 26 to fill out a mold cavity with plastic material without requiring the injection of additional material for such purpose. Thus, in Fig. 13, on completion of the injection of material into the mold cavity 58b, there remains voids 97 within the mold cavity remote

from the cavity inlet 25. On retraction of the nozzle housing 42 away from the inlet 25 to position the passageways 71 within the bore 53 to close off the injection of further material into the mold cavity 58b (Fig. 14), gas from the supply tube 55 is applied against the residual plastic 98 to fill the voids 97 as shown in Fig. 14.

It is well known that in the injection of material into a mold cavity that the air within the cavity is exhausted or released to permit conformance of the injected material with the configuration of the mold cavity. However, and as illustrated in Figs. 15 and 16, it frequently occurs that the pressure acting on the leading edges 99 moving within the mold cavity 58c encounter little or minimum pressure from the air being exhausted. As a result, these leading edges 99 frequently explode or shatter and become fragmented. This condition interferes with a smooth flow of the injected material into or against all portions of the cavity sidewall and particularly where the sidewall has an irregular or detailed surface.

To overcome this condition, the nozzle unit 26 is initially in its position of Fig. 7 to introduce air alone and under pressure into the mold cavity 58c. This air pressure is then retained within the cavity 58c during the injection operation by controlling the release of the exhausted air through a regulating valve indicated at 101 so that any tendency of the leading edges 99 of the incoming material to explode or shatter is counteracted by the applied controlled pressure within the mold cavity. As a result, the leading edges 99 retain their smooth shape for a controlled slow flow of the material into all portions of the mold cavity.

CLAIMS

1. A nozzle unit for a molding apparatus including a mold cavity for receiving a gas and an injection material, comprising:

(a) a cylindrical housing having an axial bore therethrough with a material inlet at one end and a reduced bore section at the other end thereof;

(b) a gas supply tube mounted within and extended axially of said housing;

(c) valve means in said housing for controlling the flow of gas and injection material from said housing into said mold cavity, including a valve member movably mounted in said bore for movement axially of said bore having a valve portion slidably movable within said reduced bore section to a first position wherein gas only is supplied to said mold cavity and to a second position wherein injection material alone or together with a gas is admitted to said mold cavity; and

(d) means for selectively controlling said valve means for movement to said two positions therefor.

2. A nozzle unit according to claim 1 wherein:

(a) said supply tube has an outlet end portion and said valve member has an axial bore with a first section for receiving said outlet end portion and a second reduced section in said valve portion; and

(b) a check valve unit in said valve member at the junction of said first and second bore sections.

3. A nozzle unit according to claim 1 wherein:

(a) the inner end of said housing reduced bore section terminates in a shoulder and said valve portion is of a tubular cylindrical shape formed with radial passageways; and

(b) said radial passageways are within said housing reduced bore section and said shoulder and valve portion coact to cut off the supply of injection material from said housing and through such passageways and into said mold cavity when the valve member is in said first moved position therefor.

4. A nozzle unit according to claim 2 including:

(a) means for supplying injection material under pressure into said housing;

(b) means for supplying a gas under pressure to said supply tube;

(c) said check valve unit movable to a closed position therefor in response to the pressure of said injection material and to an open position therefor in response to the pressure of said gas; and

(d) means for selectively controlling the supply of a gas to said supply tube to provide for the injection into the mold cavity of material alone or material mixed with a gas when the valve member is in the second position therefor.

5. A nozzle unit for a molding apparatus including a mold having a mold cavity with an inlet for receiving a gas and an injection material comprising:

(a) a cylindrical housing member having an axial bore with a material inlet at one end and a reduced section at the opposite end thereof;

(b) a gas supply tube mounted within said housing axially of said bore in a concentrically spaced relation with the inner peripheral surface of said bore;

(c) valve means including a valve member of a generally cylindrical tubular shape slidably mounted on said supply tube with a first end section in guidable engagement with said inner peripheral surface and a second opposite end section extended within and in bearing engagement with said reduced bore section of said housing, said opposite end section having radial passageways to receive material from within said housing for injection into said mold cavity;

(d) a check valve unit in said valve member for controlling the flow of gas from said supply tube to said mold cavity;

(e) means in said housing for yieldably moving said valve member to a first position wherein said second end section projects outwardly from said housing reduced bore section for cooperative engagement with said mold cavity inlet concurrently with the movement of said passageways within said reduced bore section; and

(f) means for moving said housing toward said mold cavity inlet to retract said second

end section of the valve member and move said valve member to a second position wherein said passageways are within said housing, whereby material within the housing is injected into said mold cavity concurrently with the closing of said check valve unit by the material entering said valve member.

6. A nozzle unit for molding apparatus including a mold having a cavity with an inlet for an injection plastic material comprising:

(a) tubular cylindrical housing unit having an injection material inlet;

(b) valve means including a tubular cylindrical valve member extended axially of said housing and having an end portion terminating at one end in a discharge outlet for operative association with said mold cavity inlet;

(c) means supporting the valve member in said housing unit for linear movement including a guide bearing for said end portion;

(d) radial passage means in said end portion; and

(e) means for moving said housing unit to control the discharge of injection material through said passage means to said mold cavity inlet, said passage means on movement of the housing unit in one direction being moved to a first closed position within said guide bearing and on movement of the housing unit in an opposite direction being moved to a second open position within said housing unit.

7. The nozzle unit according to claim 6 including:

(a) a gas supply tube in said housing unit

having an outlet open to the opposite end of said end portion of the valve member; and

(b) means for controlling the supply of gas to said end portion for injection into said mold cavity inlet together with or separately from said injection material.

8. The nozzle unit according to claim 7 including:

(a) means in said housing unit for yieldably urging said valve member in one direction to a rest position wherein said passage means are in the first position therefor.

9. A method for injecting an injection material into a mold cavity to form a molded article having a smooth outer surface comprising:

(a) initially injecting gas under pressure into the mold cavity to a predetermined value;

(b) terminating the injection of the gas to the mold cavity concurrently with injecting the injection material into the mold cavity against the pressurized gas therein; and

(c) releasing the gas from within the mold cavity to the atmosphere to provide for the expansion of the injected material within the mold cavity at a controlled rate.

10. A method for molding a plastic container with an air permeable sidewall comprising:

(a) mixing together at least two incompatible plastic materials in predetermined portions wherein the mixture on being melted forms a composite injection material consisting of said two plastic materials; and

(b) injecting said composite injection material concurrently with mixing a gas therewith to form voids between contiguous portions of the two plastic materials in said composite melted mixture.

11. The method for molding a plastic container according to claim 10 wherein:

(a) said two incompatible plastic materials are a polyethylene material and a styrene material mixed in the proportion by weight of 40 to 60 percent of the polyethylene material and 60 to 40 percent, respectively, of the styrene material; and

(b) the voids are of a size restricting liquid passage through the article sidewall.

12. The method for molding a plastic container according to claim 10 wherein:

(a) said two incompatible plastic materials are a nylon material and a rubber material mixed in proportion by weight of 40 to 60 percent of the nylon material and 60 to 40 percent, respectively, of the rubber material; and

(b) the voids are of a size restricting liquid passage through the article sidewall.

13. A method for the injection molding of articles comprising:

(a) providing a nozzle unit having a tubular cylindrical portion terminating in a discharge outlet;

(b) supplying an injection material into said tubular portion through radial passage means therein;

(c) providing an annular bearing unit to guidably support said tubular portion forlinear movement; and

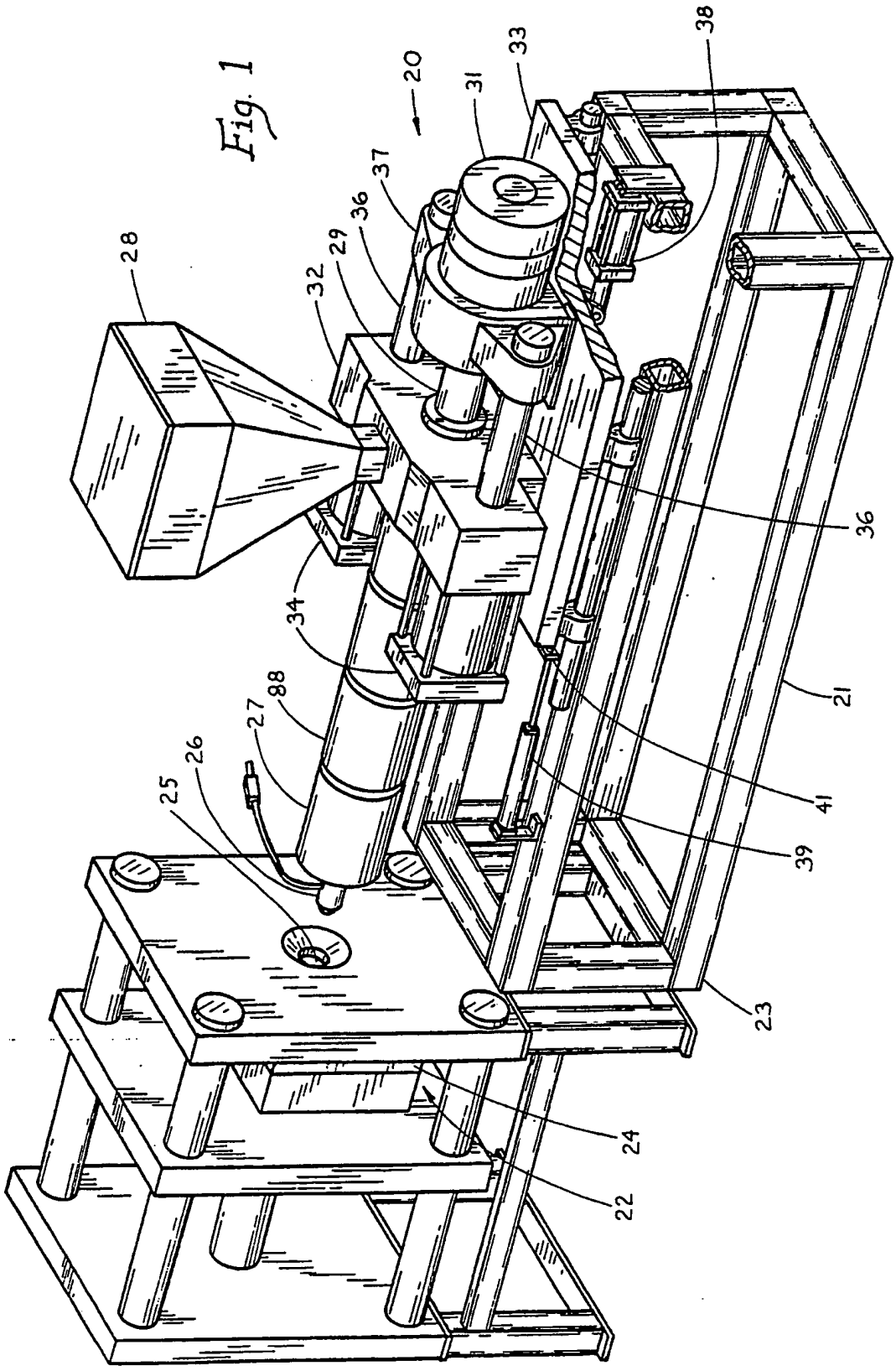
(d) controlling the supply of injection material to said passage means by moving the tubular portion in one direction to move the passage means into said guide bearing to progressively close the passage means concurrently with the guide bearing cutting off the admission of material into said passage means, and moving the tubular portion in an opposite direction to progressively move the passage means out of the guide bearing.

14. The method according to claim 13 including:

(a) supplying a gas to said tubular portion upstream from said radial passage means; and

(b) controlling the supply of gas to said tubular portion for injection into a mold cavity together with or separately from said injection material.

Fig. 1



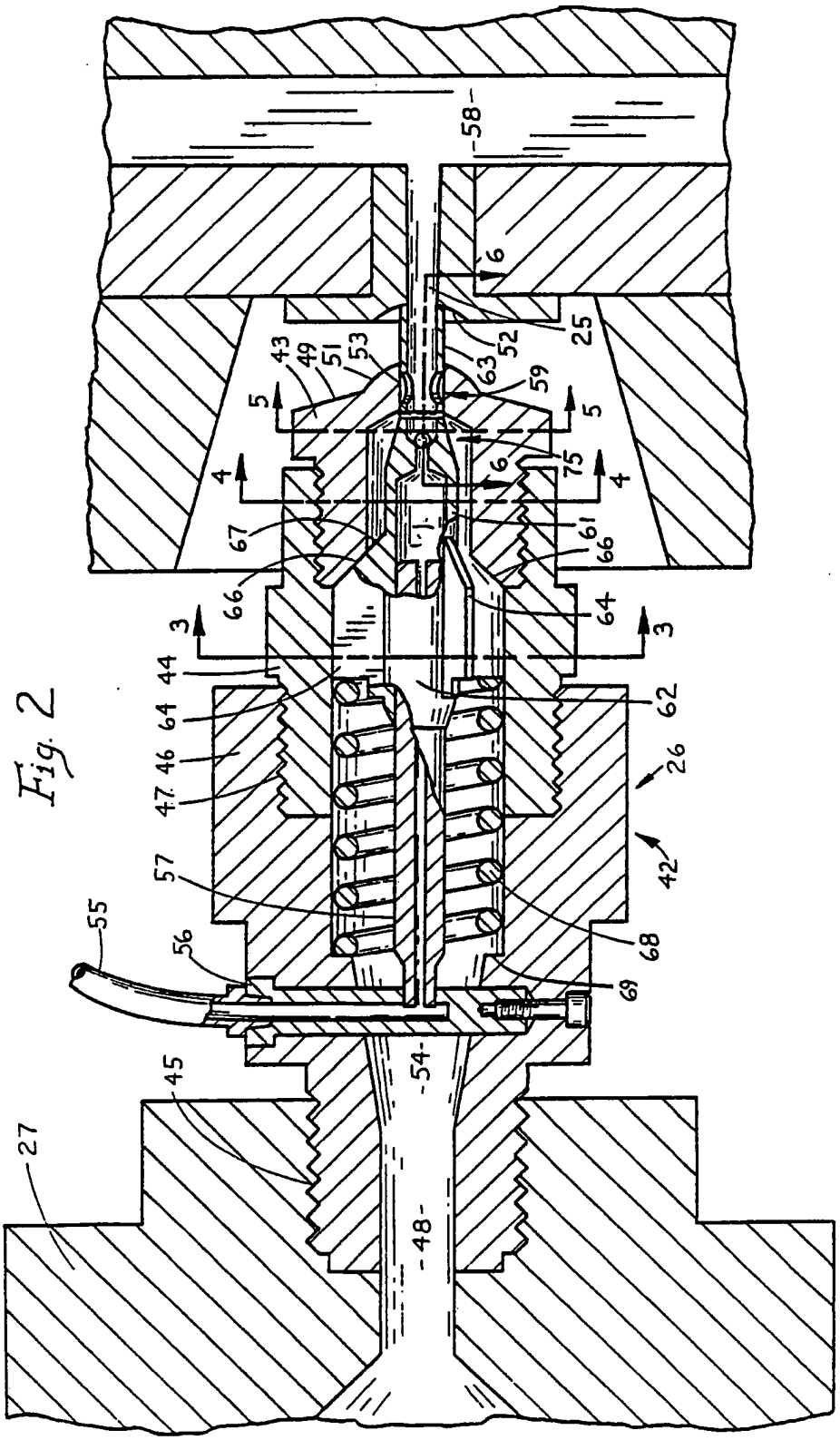

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Fig. 2

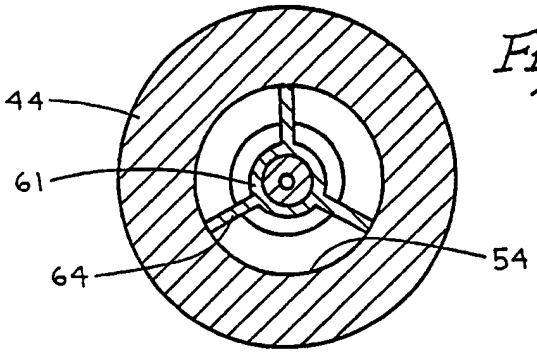

Fig. 3

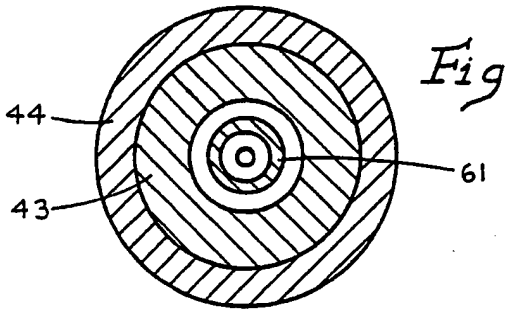

Fig. 4

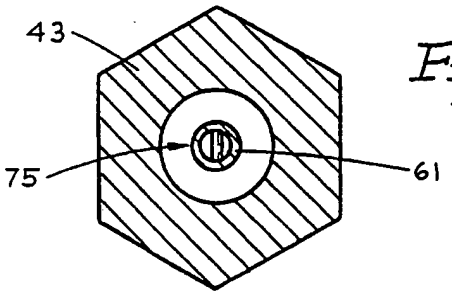

Fig. 5

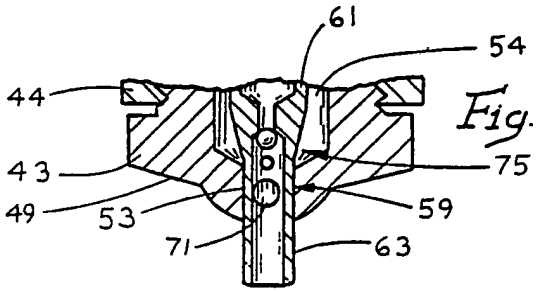

Fig. 6

Fig. 7

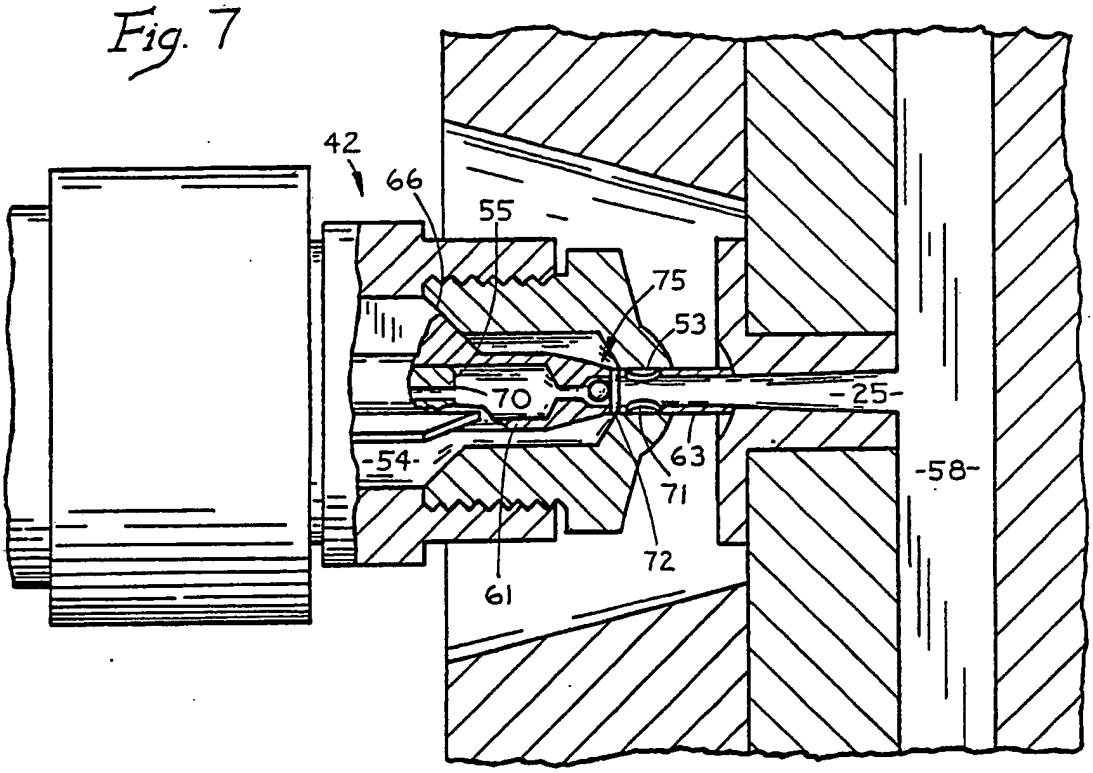
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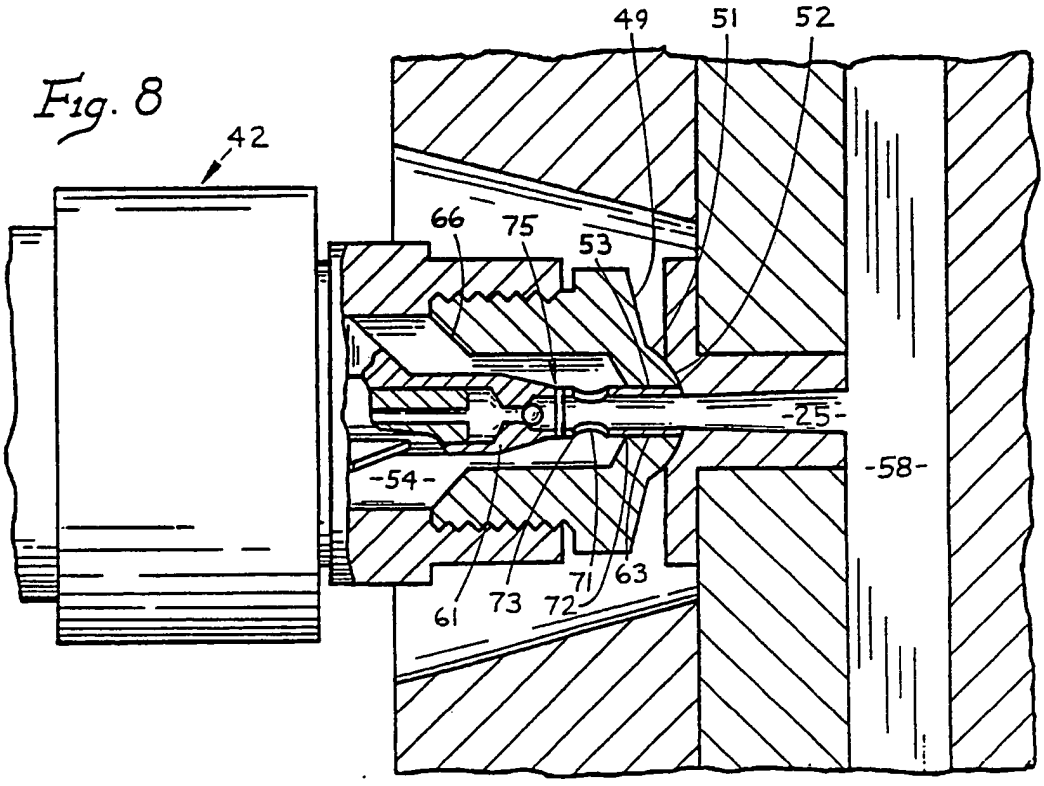
Fig. 8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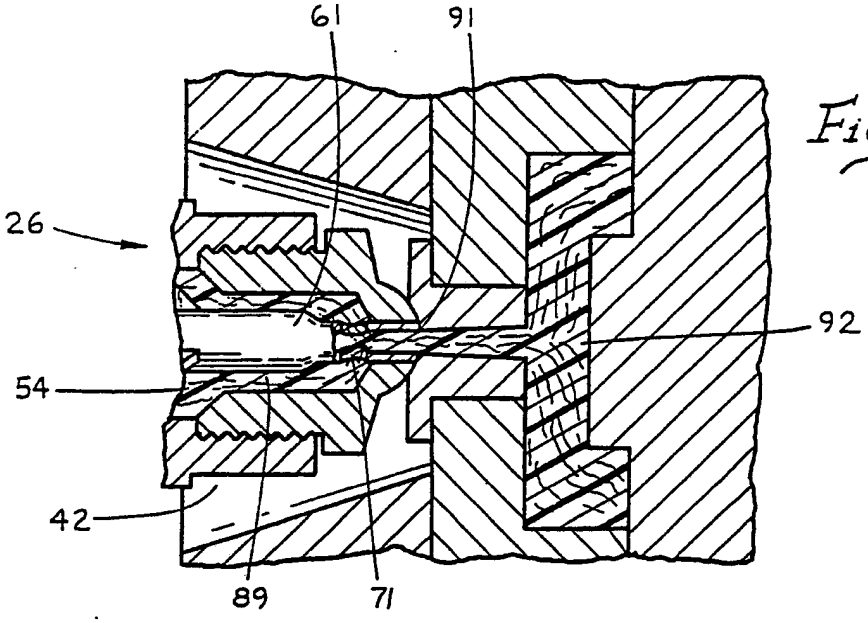


Fig. 9

Fig. 10

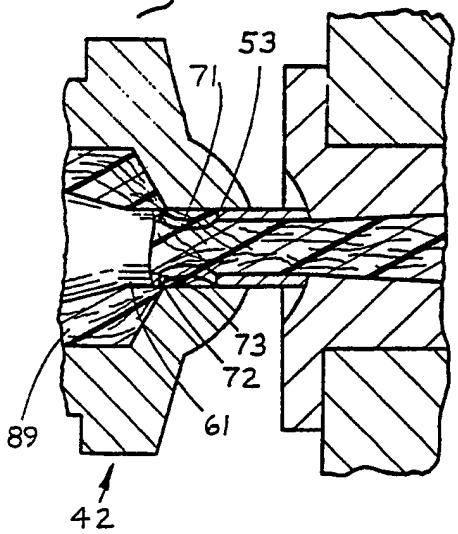


Fig. 11

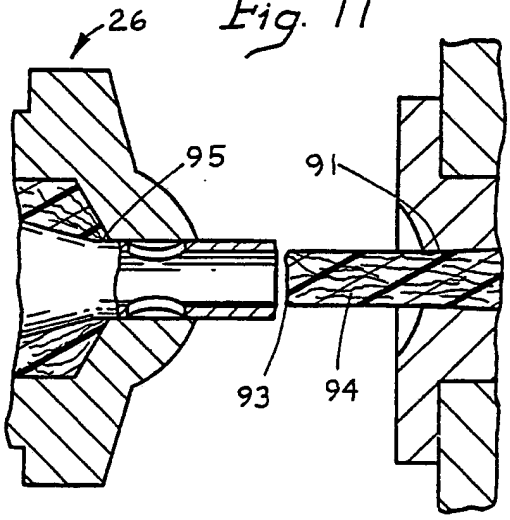
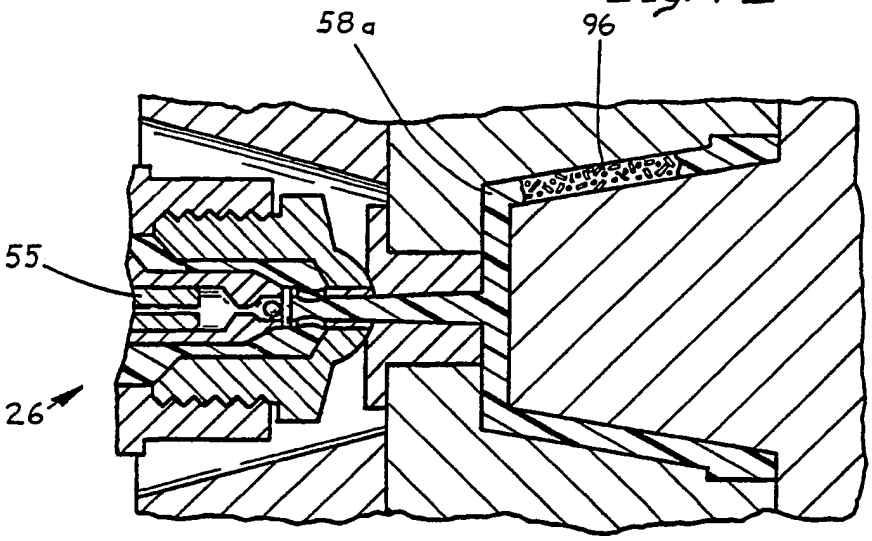


Fig. 12



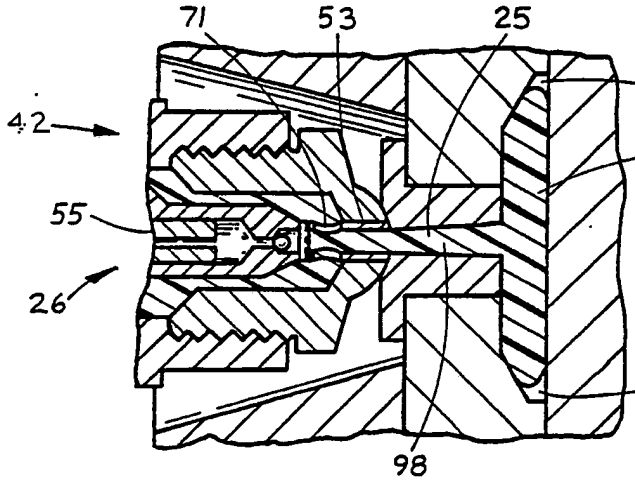


Fig. 13

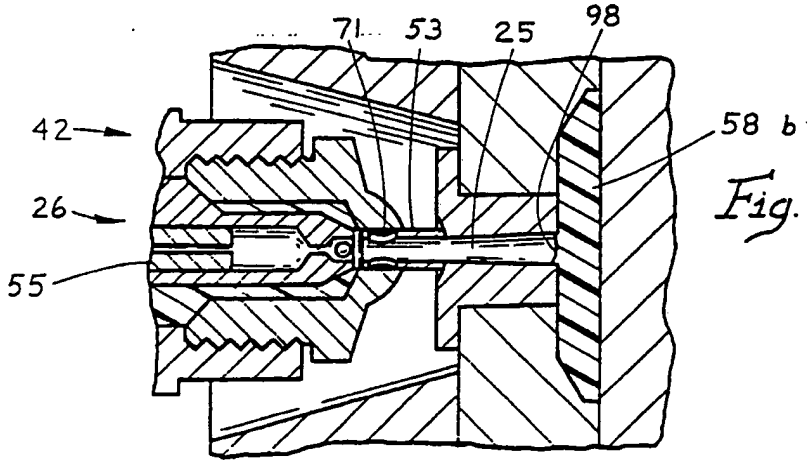


Fig. 14

Fig. 15

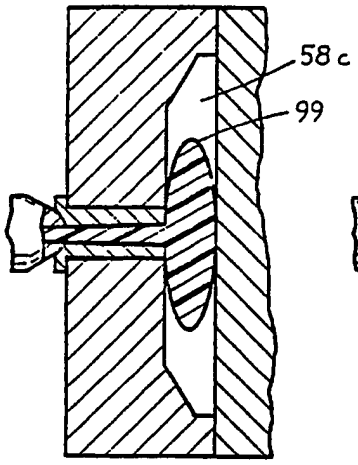


Fig. 16

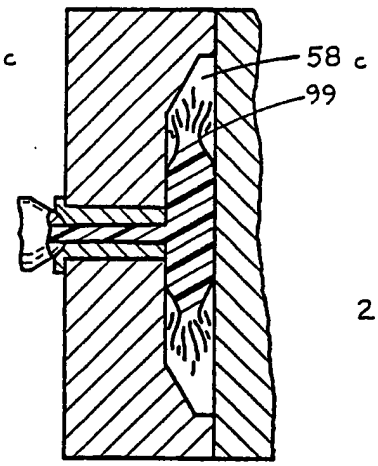


Fig. 17

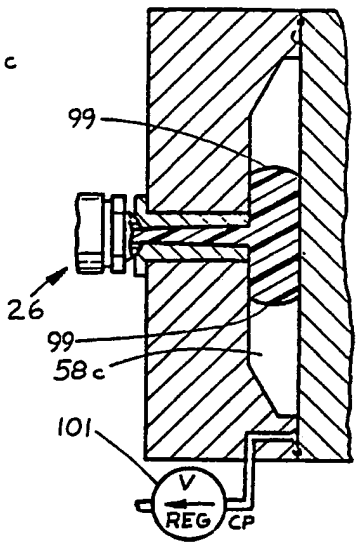
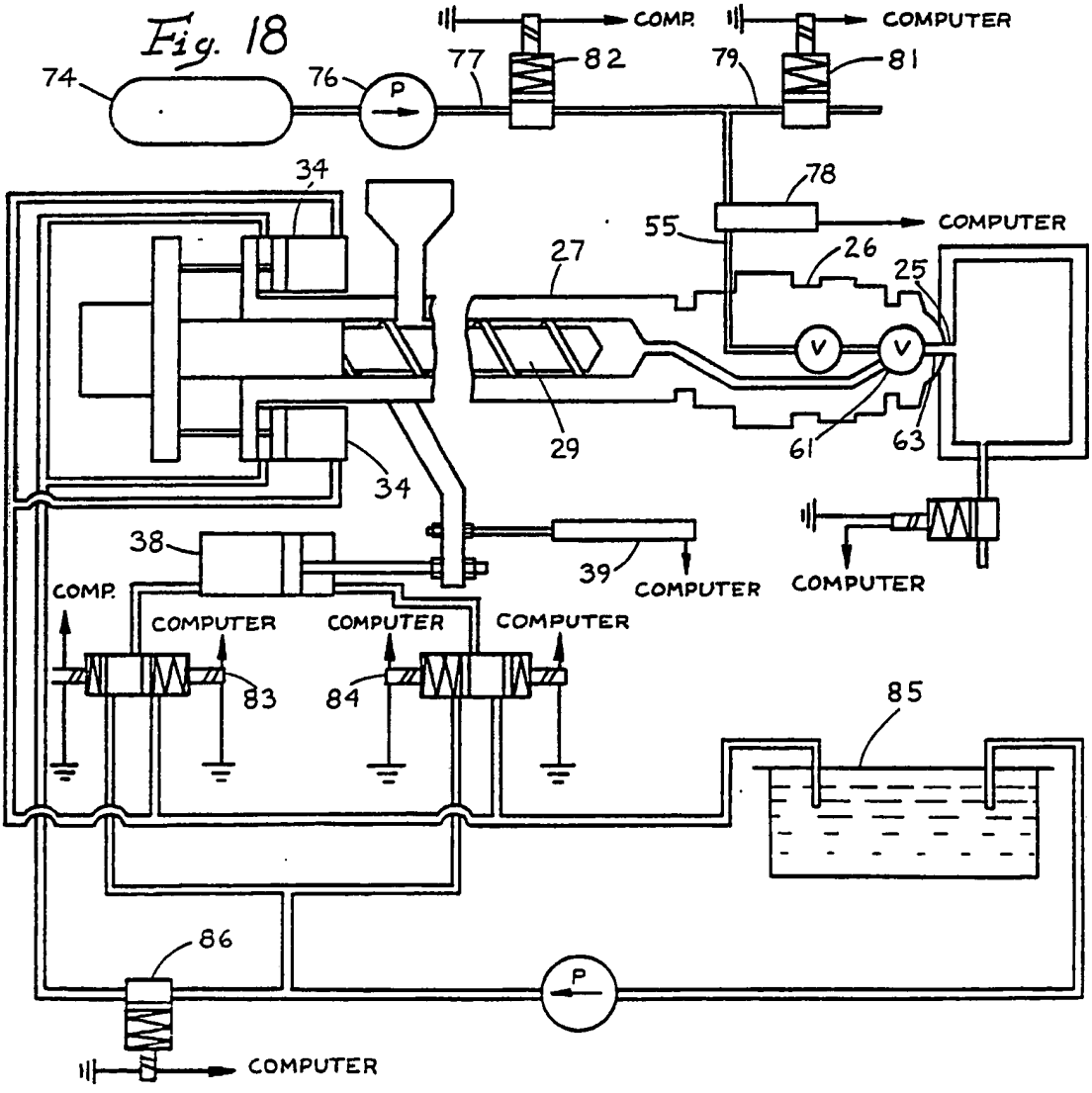


Fig. 18



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 88/01387

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 29 C 45/17; B 29 C 45/23

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 29 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	DE, A, 2716817 (ASAHI-DOW) 24 August 1978, see the whole document	1,3-5,7
Y	US, A, 2940123 (BECK) 14 June 1960, see the whole document	1,4,5,7
Y	DE, A, 1929343 (WERKZEUGBAU FUCHSLOCHER) 17 December 1970, see the whole document	1,4,5,7
Y	US, A, 3095609 (LIEVRE) 2 July 1963, see the whole document	1,3,5
X		6,8,13
X	US, A, 3268635 (KRAUS) 23 August 1966, see column 3, line 69 - column 5, line 43; figures 1,4-7	9
X	GB, A, 2148784 (TOSHIBA KIKAI K.K.) 5 June 1985, see the whole document	9

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* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14th September 1988	13 DEC 1988
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers....., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-9,13,14: method and injection nozzle for moulding apparatus.
2. Claims 10-12: method for moulding a plastic container with an air permeable sidewall.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

1-9,13,14

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 8801387 SA 22706

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 08/12/88
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 2716817	24-08-78	US-A- 4106887	15-08-78
		JP-A- 53102960	07-09-78
US-A- 2940123		None	
DE-A- 1929343	17-12-70	None	
US-A- 3095609		None	
US-A- 3268635		None	
GB-A- 2148784	05-06-85	DE-A- 3438822	09-05-85
		JP-A- 60089318	20-05-85
		US-A- 4675141	23-06-87